Technology Innovation Project

Project Brief

TIP 291: Substation Seismic Performance

Context

Benchmarking and research by industry experts in the fields of seismology, engineering geology, geotechnical engineering, civil engineering and structural engineering have found that parts of the BPA power grid suffer from periodic and random seismic events. A large portion of the BPA power grid is vulnerable to a known and documented seismic event, which periodically occurs at the Cascadia Subduction Zone. This seismic event is likely to be geographically expansive, moderately intense and last several minutes.

The Cascadia Subduction Zone event will damage a significant portion of BPA's system. The event has the potential to produce up to $10 billion in direct damage to the BPA system and resultant economic losses to the Pacific Northwest due to power outages. There are several other seismic events that could produce losses on the order of 20% to 50% of this value. Estimates are that seismic mitigation is worthwhile anywhere from approximately $131 million up to $3.4 billion for protecting against the Cascadia Subduction Zone event.

Description

This project investigates the seismic performance of existing BPA substation design policies and standards. It will analyze typical 115-, 230- and 500-kV substation bay configurations. The seismic vulnerability of existing substation designs will be determined and mitigation options evaluated.

Mitigation options to be considered include new design policies and standards for electrical equipment installations, rigid bus, flexible bus and supplemental damping devices. This project is significant for establishing available mitigation options to reduce the seismic vulnerability of BPA's transmission system. The results of this project will allow BPA to successfully address the seismic vulnerability of existing and new transmission system substations.

This project is a system approach to design policy and standards. With the system approach, BPA will be able to determine how the individual component work performs on an entire substation, as a whole. The results of this project will improve BPA's understanding of existing substation facilities, improve industry standards and improve research and development of current and future component work.

This project is located at BPA. Three substations will be visited. There will be full-scale, three-dimensional seismic table testing performed at an unknown external site. The methods to be used for this project are in accordance with BPA policies and standards as well as industry standards; IEEE 693 and IEEE 1527 will be used.

Why It Matters

This project provides significant benefits to BPA by reducing potential outages as a result of establishing superior extreme event earthquake performance of the high-voltage power transmission system. The performance of the BPA power grid is important to maintain a reliable supply of energy. As such, the BPA power grid might avoid suffering higher repair costs, more outage times, longer outage times, more damaged power transformers and more substation component damage than if the project had been performed.

Goals and Objectives

This research project evaluates the seismic performance of the BPA substation infrastructure. The project will also develop ways to mitigate seismic vulnerability.

Deliverables

The deliverables for this project are substation bay configuration models of three different substations, with a final report, and a full-scale, three-dimensional seismic table verification testing final report.

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Project Start Date: October 1, 2012

Project End Date: September 30, 2014

Reports & References (Optional)

Links (Optional)

Participating Organizations

Funding

Total Project Cost:	$385,000
BPA Share:	$385,000
External Share:	$0
BPA FY2013 Budget:	$215,000

For More Information Contact:

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